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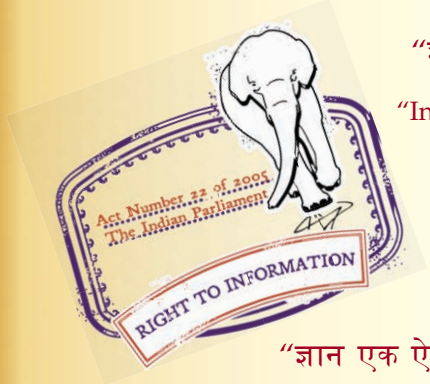
IS 11946 (1987): Soft magnetic iron strips [MTD 16: Alloy Steels and Forgings]



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"Knowledge is such a treasure which cannot be stolen"

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IS : 11946 - 1987
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Indian Standard

SPECIFICATION FOR SOFT MAGNETIC IRON STRIPS

UDC 669·127·5·018·58-418

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

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July 1987

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SPECIFICATION FOR SOFT MAGNETIC IRON STRIPS

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Indian Standard

SPECIFICATION FOR SOFT MAGNETIC IRON STRIPS

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 13 March 1987, after the draft finalized by the Special Alloys Sectional Committee had been approved by the Structural and Metals Division Council.

0.2 This standard has been prepared for rationalizing the requirements of magnetic materials which are often referred to as 'commercially pure' or 'magnetically soft' irons. This material is generally available in a wide variety of forms, such as, slabs, billets, ingots, forgings, hot rolled bars or as flat rolled sheets and strips.

0.3 The main applications for these materials are in dc relays, loudspeakers, electromagnets, magnetic clutches, brakes, parts for magnetic circuits in instruments and control apparatus as well as for pole pieces and other parts for generators and motors.

0.4 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1260*. The number of significant places retained in the rounded off values should be the same as that of the specified value in this standard.

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1. SCOPE

1.1 This standard covers requirements of cold rolled soft magnetic iron strips primarily intended for electromagnetic purposes, such as relay yoke, armature and the like of electrical machinery and apparatus.

2. SUPPLY OF MATERIAL

2.1 General requirements relating to the supply of cold rolled soft magnetic iron strip shall conform to IS : 1387-1967† and IS : 8910-1978‡.

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*Rules for rounding off numerical values (*revised*).

†General requirements for the supply of metallurgical materials (*first revision*).

‡General technical delivery requirements for steel and steel products.

2.2 Strips shall be supplied either in the from of coils or in straight lengths subject to mutual agreement between the purchaser and the manufacturer.

3. MANUFACTURE

3.1 The choice of manufacturing process is left to the supplier.

4. CHEMICAL COMPOSITION

4.1 The product analysis of the material, when carried out either by the methods specified in relevant parts of IS : 228* or any other established instrumental/chemical method shall be as given in the Table 1. In case of any dispute, the procedure given in relevant parts of IS : 228* shall be the referee method.

TABLE 1 CHEMICAL COMPOSITION (TYPICAL VALUES)

CONSTITUENT	PERCENT
Carbon	0·05
Silicon	0·2
Manganese	0·4
Sulphur	0·025
Phosphorus	0·025

5. PHYSICAL CONDITION

5.1 The material shall be uniform in composition and micro and macro structure, sound and free from physical defect or flaw both externally and internally.

5.2 The strips as received shall be smooth and flat and quite free from waviness, bow, bend or buckle.

5.3 Material in coil shall be uniformly treated and of uniform hardness and characteristics such that it shall uncoil free from waviness.

5.4 The surface of the material shall be bright, clean and smooth, and shall be free from any physical imperfections, such as rust, dirt, scale, scabs, pitting, blisters, seems, heavy score marks, etc. The surface shall be suitable for electroplating.

6. MECHANICAL PROPERTIES

6.1 Tensile Strength — The tensile strength for the material, when carried out on a test piece having a gauge length of 80 mm and a

*Method for chemical analysis of steels (*issued in parts*).

width of 20 mm, in accordance with IS : 1663-1972*, shall conform to the following requirements:

Characteristics	*Requirements*
Tensile strength, *Min*	280 MPa
Elongation, *Min*	16 percent

6.1.1 The hardness of the material shall be within the range of HRB 55-70 when determined in accordance with IS : 1586-1968†. The value of hardness is given for guidance only.

6.2 Bend Test — Bend test shall be carried out in accordance with IS : 1599-1985‡ on test pieces cut both parallel and transverse to the direction of rolling. The test piece shall be bent cold through 180° having a close bend. The test piece shall be deemed to have passed the test if the outer cover surface is free from cracks.

6.3 Grain Size — The convex surface of the bend test piece after carrying out the test as given in **6.2**, shall be smooth and shall not exhibit coarse grains or stratcher strains in the adjacent portions. 'Alternatively grain size shall be tested by using the Erichsen cupping test. The outer surface of the domes produced shall be smooth.'

NOTE — If the purchaser requires the material in any other condition, such as 'quarter hard', 'half hard' etc, the mechanical properties shall be as agreed to between the contracting parties.

7. MAGNETIC PROPERTIES

7.1 Coercive Force — The coercive force shall be determined on a test piece after annealing at 800°C for 3 h under atmospheric conditions of controlled decarborization and cooling in the furnace at a maximum cooling rate of 60°C/h or as per manufacturers recommendations. The annealed test piece shall be tested on a 'FORSTER' type coercimeter or conventional balliatic flux meter method. The value of the coercive force, after magnetising to 16 000 Gauss shall not exceed 1·0 oersted (0·8 A/cm).

7.2 Ageing — The difference between the measured value of the coercive force after ageing the specimen at 100 ± 5°C for 300 h, and the initial value shall be less than 10 percent.

*Method for tensile testing of steel sheet and strip of thickness 0·5 mm to 3 mm (*first revision*).

†Methods for Rockwell hardness test (B and C scales) for steel (*first revision*).

‡Method for bend test (*second revision*).

7.3 Magnetic Induction — After annealing as per manufacturer's specification or at 800°C for 3 h and cooled slowly in the furnace at the rate of 60°C/h, *Max* the magnetizing curve must show the following minimum values:

Field Strength		*Induction*		*Field Strength*		*Induction*	
Oe	A/cm	Gauss	μVS/cm²	Oe	A/cm	Gauss	μVS/cm²
1·25	(1)	9 000	(90)	6·25	(5)	13 000	(130)
2·50	(2)	11 000	(110)	12·5	(10)	14 500	(145)
3·75	(3)	12 000	(120)	50	(40)	16 000	(160)

7.4 Remanence — After magnetizing with 16 000 Gauss (160 μVS/cm²) the indicative value for the remanence is 11 000 Gauss.

8. DIMENSIONAL TOLERANCES

8.1 Unless otherwise agreed to between the contracting parties, the dimensional tolerances shall be as given in Tables 2, 3, 4 and 5.

9. MATERIAL IN COIL

9.1 The size and eye diameter of the coil shall be mutually agreed between the purchaser and the manufacturer.

10. SAMPLING FOR TESTS

10.1 One representative sample for a lot shall be taken for tensile testing. A lot shall consist of 30 tonnes or less of strip of the same quality rolled to the same thickness and condition. If the lot consists of more than one heat, samples from each heat shall be tested.

10.2 For hardness, grain size, bend test and other magnetic properties one sample from each lot of 5 tonnes or part thereof shall be taken.

11. RETESTS

11.1 Should any of the test pieces first selected fail to pass any of the tests specified in this standard, two further samples shall be selected from the same lot for testing in respect of each failure. Should the test pieces from both the additional samples pass, the material represented by the test samples shall be deemed to comply with the requirements of that particular test. Should the test pieces from either of these additional samples fail, the material represented by the test sample shall be deemed as not conforming to this standard.

TABLE 2 TOLERANCES ON THICKNESS OF STRIPS

(*Clause* 8.1)

All dimensions in millimetres.

Thickness	Tolerances for Nominal Width				
	Up to 80	Above 80 Up to 125	Above 125 Up to 250	Above 250 Up to 450	Above 450
(1)	(2)	(3)	(4)	(5)	(6)
Up to 0·10	± 0·01	± 0·01	—	—	—
Above 0·10 up to 0·16	± 0·02	± 0·02	± 0·03	± 0·03	± 0·03
Above 0·16 up to 0·20	± 0·02	± 0·02	± 0·03	± 0·03	± 0·03
Above 0·20 up to 0·25	± 0·03	± 0·03	± 0·03	± 0·03	± 0·03
Above 0·25 up to 0·32	± 0·03	± 0·03	± 0·04	± 0·04	± 0·04
Above 0·32 up to 0·40	± 0·03	± 0·03	± 0·04	± 0·04	± 0·04
Above 0·40 up to 0·50	± 0·03	± 0·04	± 0·04	± 0·05	± 0·05
Above 0·50 up to 0·63	± 0·04	± 0·04	± 0·05	± 0·05	± 0·05
Above 0·63 up to 0·80	± 0·04	± 0·05	± 0·05	± 0·05	± 0·05
Above 0·80 up to 0·90	± 0·05	± 0·05	± 0·05	± 0·06	± 0·06
Above 0·90 up to 1·00	± 0·05	± 0·05	± 0·05	± 0·06	± 0·06
Above 1·00 up to 1·25	± 0·05	± 0·06	± 0·06	± 0·07	± 0·07
Above 1·25 up to 1·60	± 0·05	± 0·06	± 0·06	± 0·08	± 0·08
Above 1·60 up to 1·80	± 0·05	± 0·06	± 0·07	± 0·08	± 0·09
Above 1·80 up to 2·00	± 0·06	± 0·06	± 0·08	± 0·09	± 0·09
Above 2·00 up to 2·50	± 0·06	± 0·08	± 0·08	± 0·09	± 0·11
Above 2·50 up to 4·00	± 0·06	± 0·08	± 0·08	± 0·09	± 0·11
Above 4·00 up to 5·00	± 0·09	± 0·10	± 0·10	± 0·11	± 0·13

TABLE 3 TOLERANCE ON SPECIFIED WIDTH OF STRIP

(*Clause* 8.1)

All dimensions in millimetres.

Nominal Thickness	Tolerances on Nominal Width			
	Up to 160	Above 160 Up to 250	Above 250 Up to 400	Above 400 Up to 600
Up to 0·60	± 0·15	± 0·20	± 0·25	± 0·30
Above 0·60 up to 1·00	± 0·20	± 0·25	± 0·25	± 0·30
Above 1·00 up to 1·60	± 0·20	± 0·30	± 0·30	± 0·40
Above 1·60 up to 2·50	± 0·25	± 0·35	± 0·40	± 0·50
Above 2·50 up to 4·00	± 0·30	± 0·40	± 0·45	± 0·50
Above 4·00 up to 5·00	± 0·40	± 0·50	± 0·55	± 0·65

TABLE 4 TOLERANCE ON LENGTH OF SHEETS AND STRIPS (CUT LENGTH)

(*Clause* 8.1)

LENGTH	TOLERANCE
Up to 2 000 mm	$+\ 15\ {}^{}_{-\ 0}$ mm
Above 2 000 mm	$+\ 0{\cdot}75\ {}^{}_{-\ 0}$ percent of length

TABLE 5 CAMBER TOLERANCE FOR COILS AND CUT LENGTHS NOT RESQUARED

(*Clause* 8.1)

FORM	CAMBER TOLERANCE
Coils	20 mm in any 5 000 mm length
Cut lengths	0·4 percent × length

NOTE — Camber is the greatest deviation of a side edge from a straight line, the measurement being taken on the concave side with a straight line.

12. PACKING

12.1 Each strip/coil shall be treated on both sides with non-hardening type rust-preventing oil, which can be easily washed with aqueous alkali solution.

12.2 The mass of each case shall be mutually agreed between the purchaser and the manufacturer. The material shall be well protected from damages and corrosion during transit. The bundle shall be wrapped with hessian water-proof cloth and tied with hoop iron. External packing shall be done with strong wooden cases or crates to prevent damage to the edges.

13. MARKING

13.1 The following shall be legibly marked on the top of each bundle or package of strips or as shown on a tag attached to each coil:

a) Manufacturer's name and trade-mark,

b) Quality/grade,

c) Product dimensions,

d) Cast or identification mark by which the strip may be traced to cast or casts from which they are made,

e) Net and gross weight, and

f) Date of despatch.

13.2 The material may also be marked with the Standard Mark.

NOTE — The use of the Standard Mark is governed by the provisions of the Bureau of Indian Standards Act 1986 and the Rules and Regulations made thereunder. The Standard Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well-defined system of inspection, testing and quality control which is devised and supervised by BIS and operated by the producer. Standard marked products are also continuously checked by BIS for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

INTERNATIONAL SYSTEM OF UNITS (SINUITS)

Base Units

Quantity	Unit	Symbol
Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Luminous intensity	candela	cd
Amount of substance	mole	mol

Supplementary Units

Quantity	Unit	Symbol
Plane Angle	radian	rad
Solid angle	steradian	sr

Derived Units

Quantity	Unit	Symbol	Definition
Force	newton	N	1 N = 1 $kg.m/s^2$
Energy	joule	J	1 J = 1 N.m
Power	watt	W	1 W = 1 J/s
Flux	weber	Wb	1 Wb = 1 V.s
Flux density	tesla	T	1 T = 1 Wb/m^2
Frequency	hertz	Hz	1 Hz = 1 c/s (s^{-1})
Electric conductance	siemens	S	1 S = 1 A/V
Electromotive force	volt	V	1 V = 1 W/A
Pressure, stress	pascal	Pa	1 Pa = 1 N/m^2